MAGNETIC FIELD SENSING DEVICE FOR COMPASSING AND SWITCHING

BACKGROUND

1. Field of Invention

The present invention generally relates to magnetic field sensing, and more particularly to a magnetic field sensor device that can be used in both compassing and power switching functions.

2. Description of Related Art

Magnetic field sensors are designed to detect changes or disturbances in magnetic fields. From this initial detection, the sensors are able to derive information on properties such as direction, presence, rotation, angle, or electrical currents. Magnetic field sensing has a variety of applications including navigation, medical diagnostics, surveillance, mechanical component characterization, and detection of minerals, electrical devices, and power lines.

Consumer and non-consumer devices are constantly being updated to include more and more features. Magnetic field sensing is likely to become a part of many of these devices. For example, cell phones will be able to provide compassing functions by including magnetic sensing circuitry in their designs. Cell phones (e.g. flip-style or sliding-style phones) can also use a magnet and magnetic sensor to determine when a user has opened the phone, so that the screen can be powered up. Other consumer devices, such as Personal Digital Assistants (PDAs), portable computers (e.g. notebook computers), and handheld GPS receiver units could similarly make use of magnetic field sensing to provide increased functionality to the user.

For flip-style cell phones, switching typically has been achieved by placing a Hall Effect sensor in one panel of the phone and a permanent magnet in the other panel of the phone. When the phone is closed, the sensor and magnet are in close proximity, such as on top of each other. A voltage is applied to the sensor in such a way that in this closed configuration the Hall voltage is zero and power to the display and/or other components is off. When the phone is opened the sensor and the magnet are no longer in close proximity. Given the same applied voltage in this open configuration, a Hall voltage will be created and power can be switched on (e.g. to light up the screen display).

Magnetic compassing sensors and on/off power switching sensors are typically separate, unintegrated devices. The two sensors are designed to measure different target magnetic fields: the compassing sensors measure the Earth's magnetic field, while power switching sensors measure the close presence of a permanent magnet, for example.

Because size and cost are primary drivers in many consumer devices, a single magnetic field sensor device that combines both magnetic compassing and on/off power switching would be desirable. This device would be able to distinguish between a compassing signal and a power switching signal.

SUMMARY

One embodiment provides for a magnetic field sensing device for compassing and switching used within a portable information device. The device is comprised of a magnet and a two axis magnet sensor. The magnetic sensor is used as a compass when the magnet is placed away from the magnet. When the magnet is brought close to the sensor, the sensor creates a signal that can be used by circuitry, such as a processor, to process the signal. The processor can then de-active circuits, turn off external components such as lights or speakers as well as perform various other functions.

These as well as other aspects and advantages of the present invention will become apparent to those of ordinary skill in the art by reading the following detailed description, with appropriate reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the present invention are described with reference to the following drawings, wherein:

FIG. **1** is a pictorial diagram of a cell phone having a flip-panel;

FIG. **2** is a pictorial diagram of a cell phone having a slide-panel;

FIG. **3** is a pictorial diagram of a notebook computer;

FIG. **4** is a block diagram of a device having an electronic compass and a magnetic switch, according to an embodiment of the present invention;

FIG. **5** is a block diagram showing the device of FIG. **4** in further detail;

FIG. **6** is a block diagram of a device having a magnetic field sensing device for two-dimensional compassing and switching, according to a first embodiment of the invention;

FIG. **7** is a block diagram of a device having a magnetic field sensing device for two-dimensional compassing and switching, according to a second embodiment of the invention;

FIG. **8** is a block diagram of a device having a magnetic field sensing device for two-dimensional compassing and switching, according to a third embodiment of the invention;

FIG. **9** is a block diagram of a device having a magnetic field sensing device for three-dimensional compassing and switching, according to a fourth embodiment of the invention;

FIG. **10** is a block diagram of a device having a magnetic field sensing device for three-dimensional compassing and switching, according to a fifth embodiment of the invention;

FIG. **11** is a circuit diagram of a magnetic field sensing device that can be assembled with standard electronic components; and

FIG. **12** is a graph showing the voltage response of a typical magnetic sensor in the presence of a magnetic field;

DETAILED DESCRIPTION

In view of the wide variety of embodiments to which the principles of the present invention can be applied, it should be understood that the illustrated embodiments are examples only, and should not be taken as limiting the scope of the present invention.

FIG. **1** is a pictorial drawing of a typical flip-style cell phone **100** having a display panel **104** and a keypad panel **108**. The display panel comprises a backlit display **106** as well as other components such as a speaker, external LED lighting and various other elements. In this embodiment, a magnet is embedded inside the display panel. The keypad panel **108** comprises numeric or alphanumeric keys, as well as additional elements such as volume control keys, a headset jack and additional control keys. Additionally, the keypad panel incorporates a magnetic sensor. When the cell phone is closed, the embedded magnet, in close contact with the magnetic sensor, keeps at least some cell phone functions in an off or standby state. Conversely, when the phone is opened the magnet moves away from the magnetic sensor and the cell phone is turned on or made active. For example, a variety of responses may occur upon opening the phone, including the